ESC Energy Consumption Reduction Efforts

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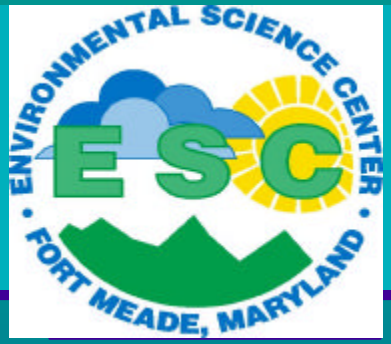

We're

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Topics

- Background
- Status of changes
- Graphics
- Lessons Learned
- To do

Background

- H&S #1 priority
- Energy Management & Data recent priorities
- ESC 4th largest EPA Lab
- Adopting VAV concept for EPA Labs
- Initially all VAV labs seem to use more energy than labs they replaced
  - Ft. Meade (ESC)
  - Athens
  - Golden

Goals for ESC

- Reduce Energy Consumption
- Extend Life of Equipment
- $ Save Money
- Automate over manual control

Starting Out

- Building opened February 1999

✓Construction Inspections throughout

×No Formal Commissioning performed

Design start up with:

- ✓25% expansion built into mechanical equip
- ✓CAV design switched to VAV at 80-90% design
- ✓100% diversity switched to 80%
- ✓BAS programmed OCC = UNOCC conditions
- ✓Some initial architectural data in error
- ✓Air Balancing data suspicious

No Formal Commissioning

- Left up to Occupants to find out operations
- HQ w/R3&OPP contracted for follow on commissioning
  - Recommendations
  - Extra help for warranty items
  - Speak the lingo of construction
- Size of O&M relatively small for first year
  - Underestimated need to balance learning curve, warranty work and new work

Design started with.....

- 25% expansion built into mechanical equip
  - Initial settings set to MAX air, water flow, heat conditions
- Mix of pneumatic and electrical DDC activators
- Are the static pressure sensor points in the right spot? Yes
- DDC uses different equipment UC v. TEC

Design/Safety - Problems?

- CV design switched to VAV at 80-90% design
- Boilers oversized. Efficient boilers can't run efficiently at demand we need for 7-8 mo/yr
- 100% diversity switched to 80%
  - Net result is BIG equipment running inefficiently
- ACH 4, 6, 8, 12?
  - ☞20-36 ACH in reality
- Actual fumehood use rarely above 35% during Occ

Design Lessons continued

- BAS programmed OCC = UNOCC conditions
  - Air numbers give MAXIMUM safety protection all hours of the day
  - Equipment set to run 24/7 full out
- Original data in error (e.g. RH settings)
  - RH initially set to 60% year round. Adjusted to 40%
- No correlation with outside air RH and need for chiller use

Design issues?

- Air Balancing data suspicious
  - ✪ Static pressure set high to provide enough air to hoods. Initial 1.0" crept up to 2.0"
  - ☞ EFs 95-99% of rated motor speed
  - ✘ GX and fumehoods acted as CV in some cases
- Bypass damper failed repeatedly
  - ● electronic unit couldn't be kept dry
  - ★ pneumatic replacement
- Empirical numbers for exhaust

What have we done to date:

- Turned off unneeded AHU
  - ✓AHU 7 in winter (Oct 2000)
  - ✓AHU 5 at night and weekends (June 1999)
  - ✓AHU 6 nightset back (Sept 2001)
  - ✓AHU 4 manually off night and weekends (Feb 2001) (Now on automatic BAS control)
- Turned off Transfer fans night/weekends
- Turned off Exhaust fans night/weekends (toilets, small dedicated units)

☞ With new S&H numbers routinely running 3 lab AHUs instead of 4 during OCC times!

More.....

- Altered supply discharge temp 55 - 60 - 58 F
- Altered chiller activation temp from 55 to 62F (adjustable)
- Adjustable hot water supply from 160 -180 F depending outside air sensor
- Stairwells warm in summer, cooler in winter
- Placed corridor lighting on switches (June 2001)
- Placed parking lot lights on photocells
- Alter exit velocity from 3,000 to 1,900 ft/min

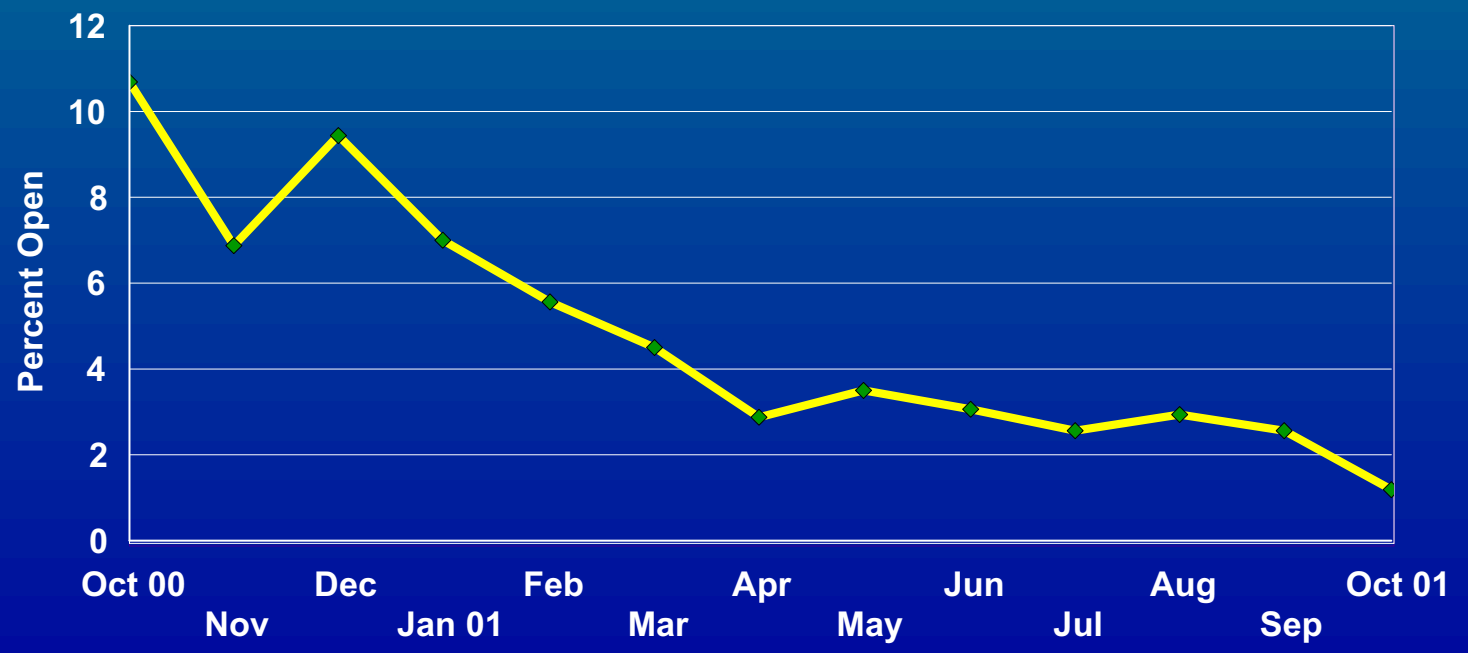
More II

- Changed sequence of cooling tower to increase # of fans before bringing on another chiller (manual)
- Tied outside RH into sequence of chiller operation (shoulder season benefits)
- Activated Nightsetback for 22 labs plus D, E and J wings
- Fixed room differential double count
- Limit Unocc and Weekend work

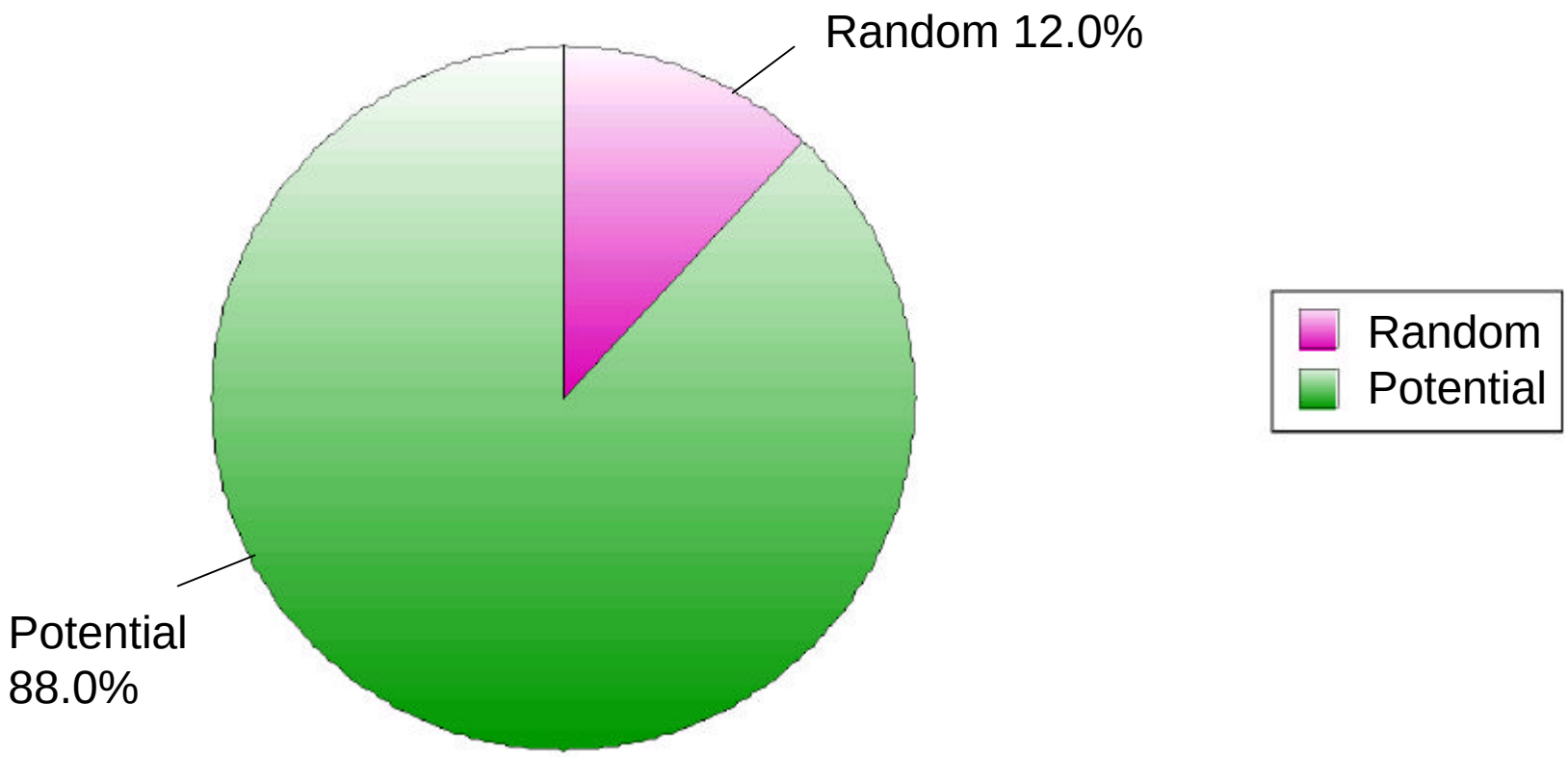
Plus...

- Contract for new set point & programing the new values
- Test and trend conditions
- Monitor changes with trend reports
- Monitor changes to energy consumption
- Contracted to monitor sash opening status
- Decrease condenser water range from 78/81 to 76/81 low speed and 82/85 to 81/85F for high speed (Adjustable)

Fumehoods Open at Night



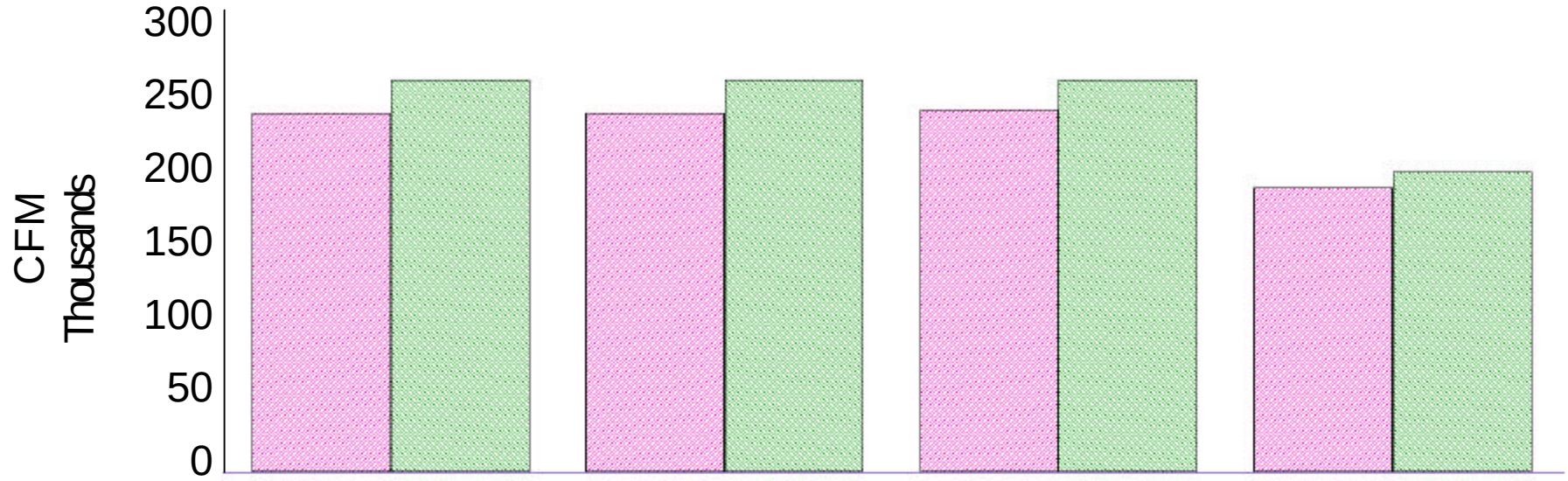
Fumehoods Open Occ Hours



Temperature Adjustments

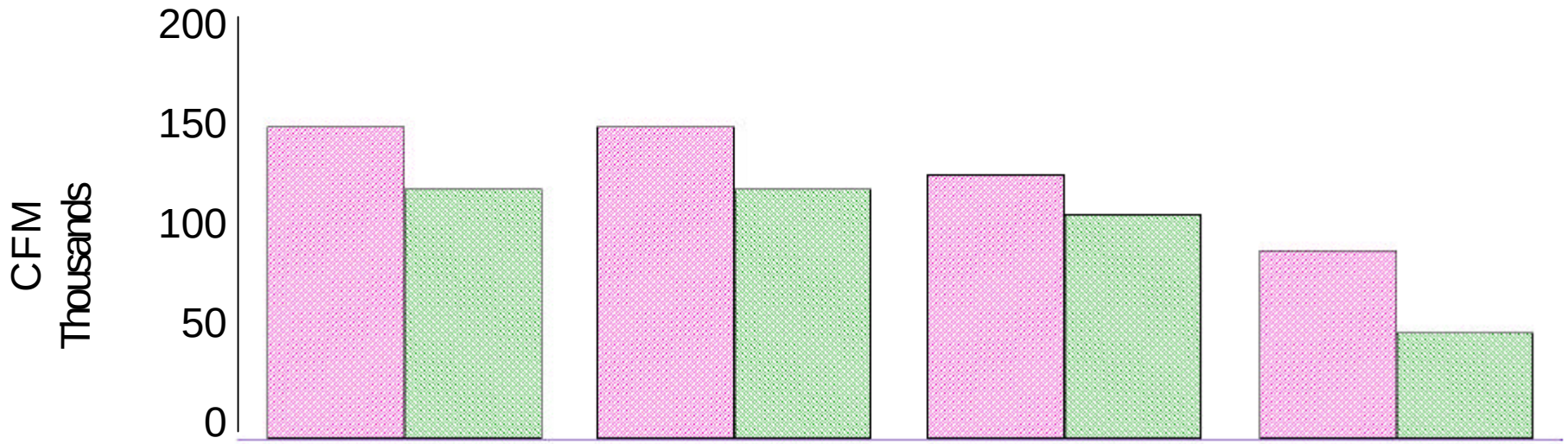
- Altered lab and office temps (Max in room)
  - winter (Oct 15 - May 15)
    - corridors: 68 F Occ 66 F Unocc
    - labs: 70 F 66 F
    - offices: 72 F 66 F
  - summer (May 16 - Oct 14)
    - corridors: 74 F Occ 78 F Unocc
    - labs: 72 F 72 F
    - offices: 74 F 78 F

Maximums



	Org OCMX	Org UNMX	RV OMX	RV UNMX
Supply	251,460	251,460	252,659	197,732
Exhaust	273,070	273,070	273,699	208,327

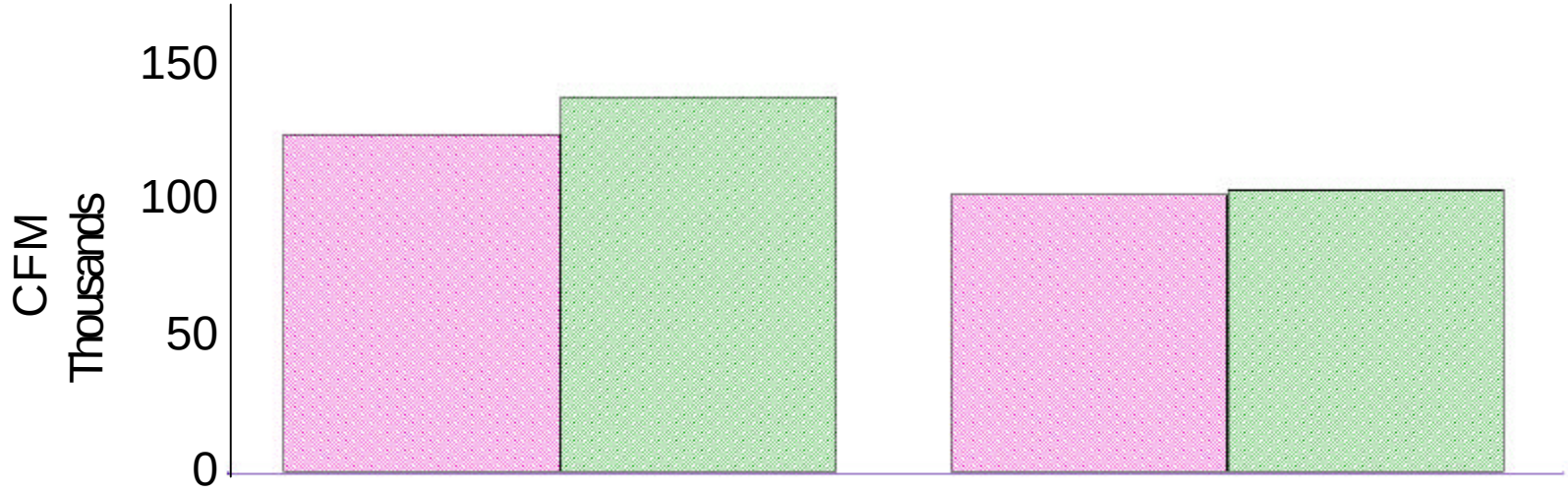
Minimums



	Org OCMN	Org UNMN	RV OCMN	RV UNMN
Supply	145,976	145,976	123,714	87,605
Exhaust	117,595	117,595	105,038	49,341

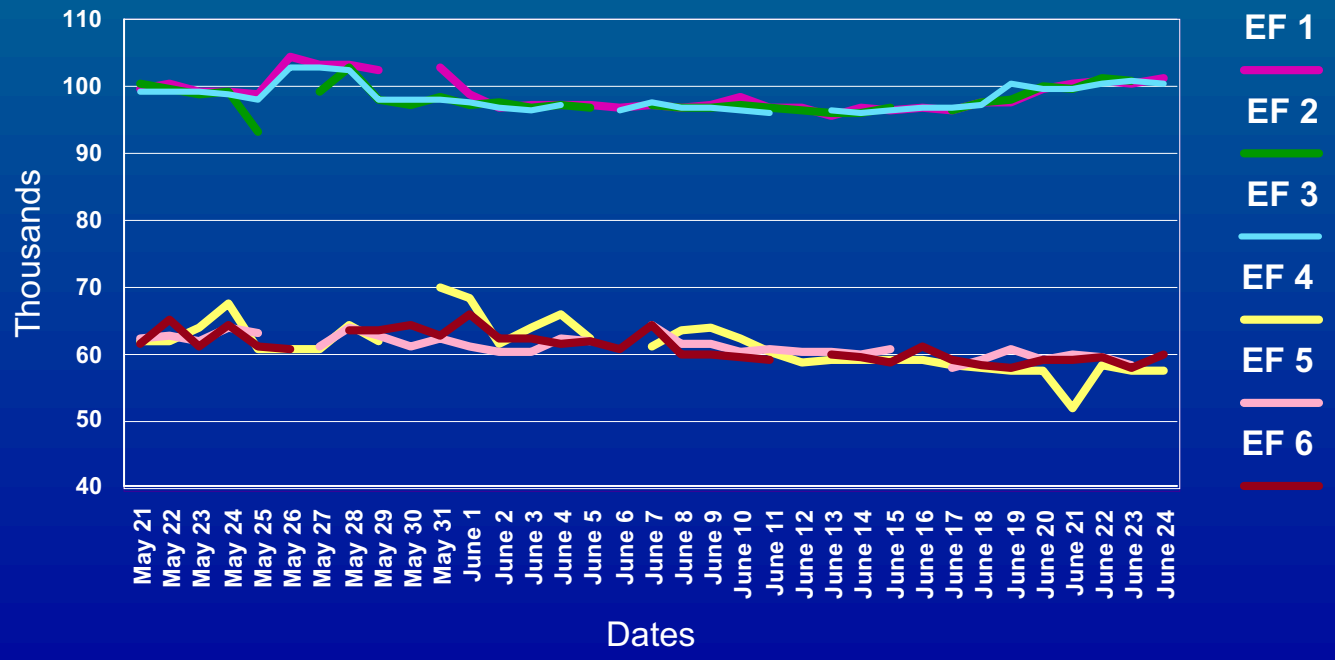
C=TKLP/Siemens, R=Syska & Hennessy

Actual Values Trended

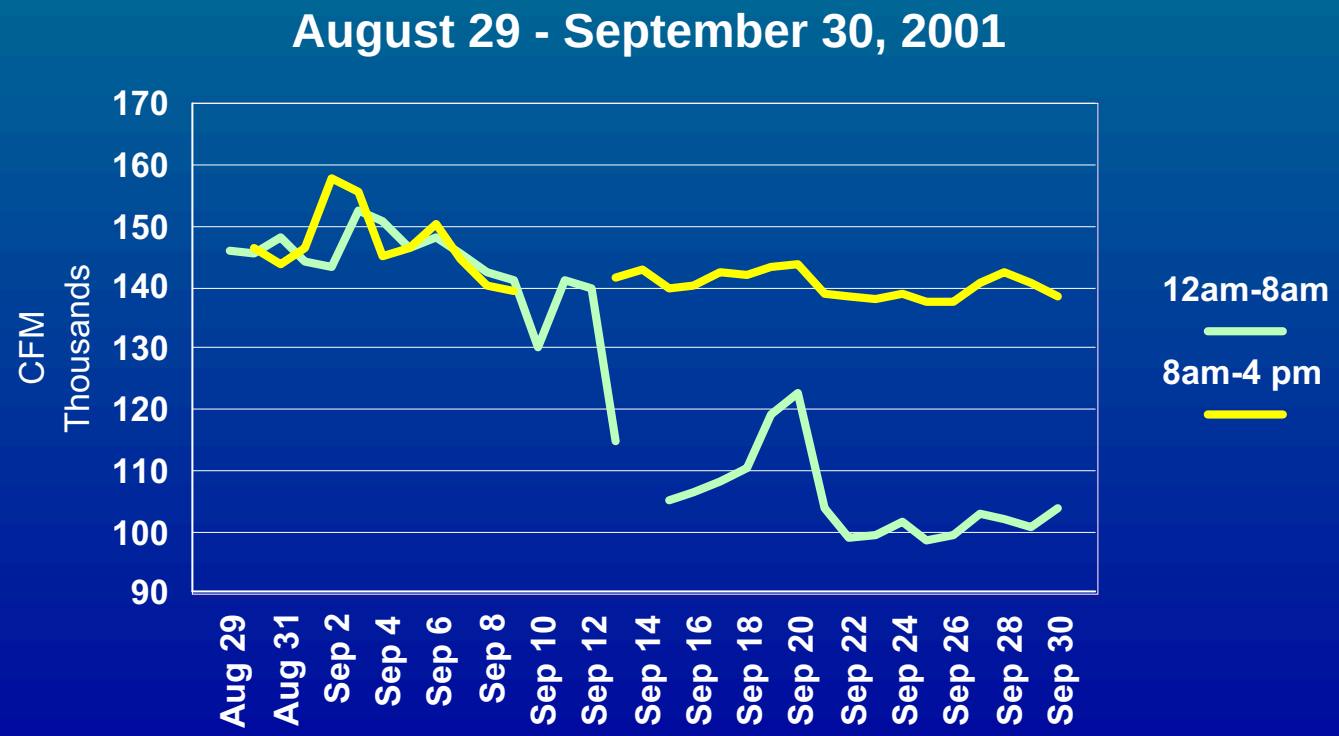


	Occ Avg	Unocc Avg
supply avg	125,783	103,518
exhaust	140,443	105,272

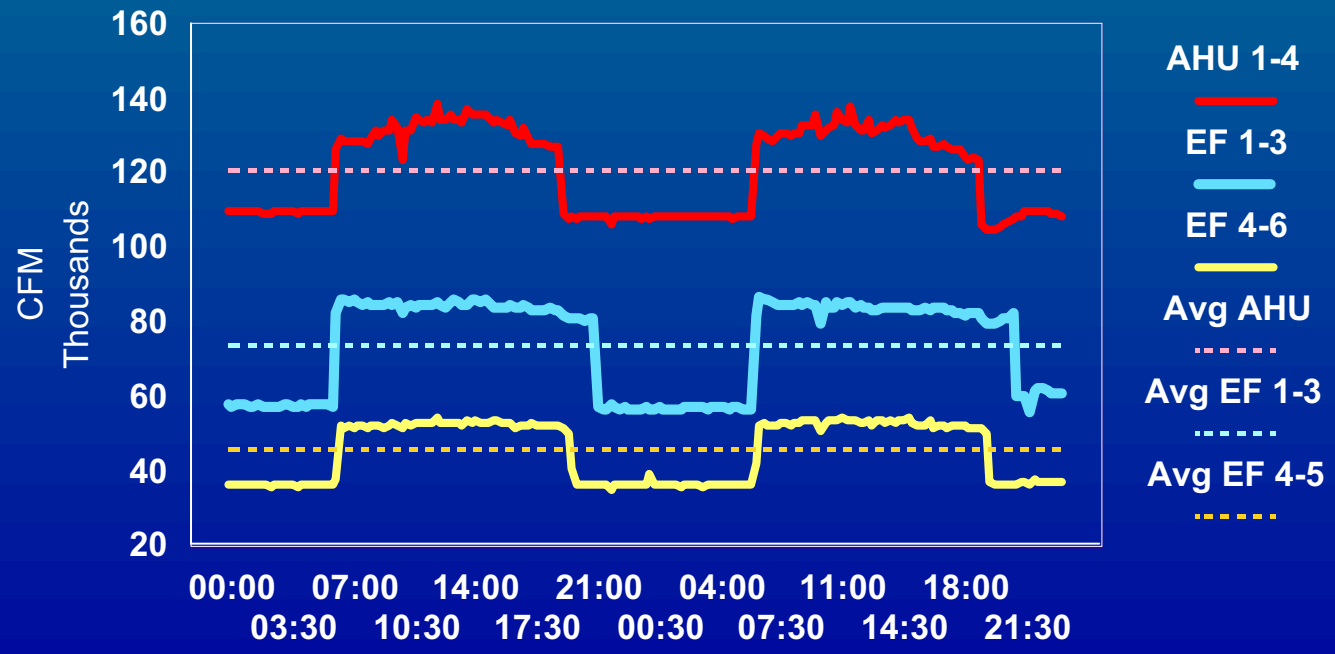
Exhaust Fans before Setback



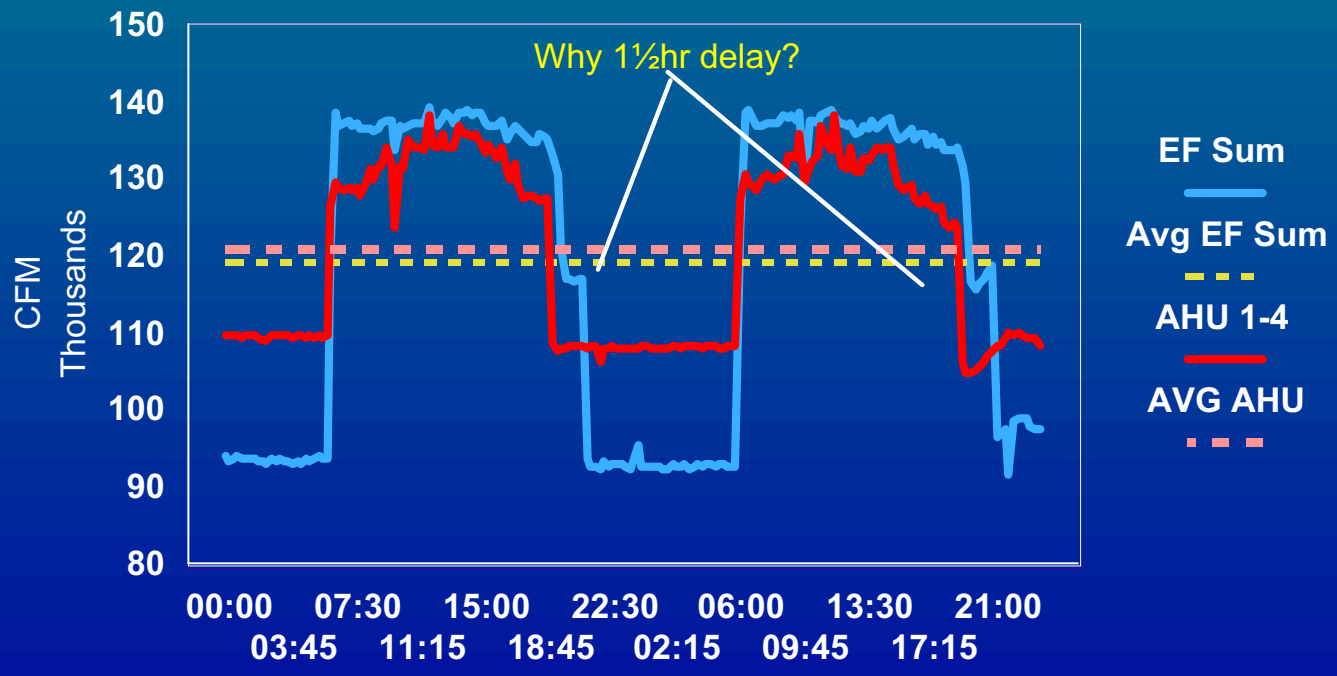
EF Gross Exhaust Change



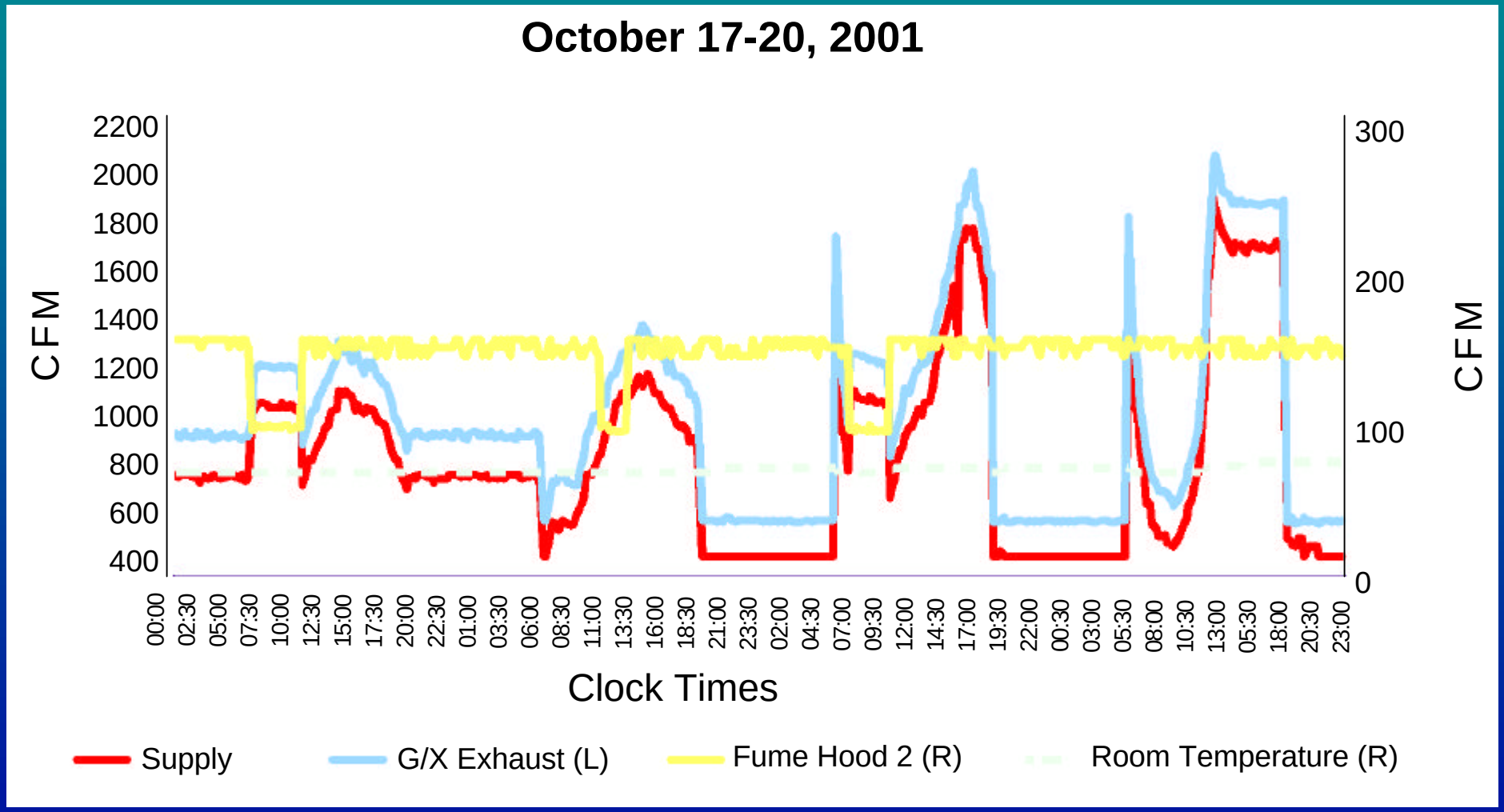
Lab AHUs & EF 1-6



AHUs and EF 1-6 Combined

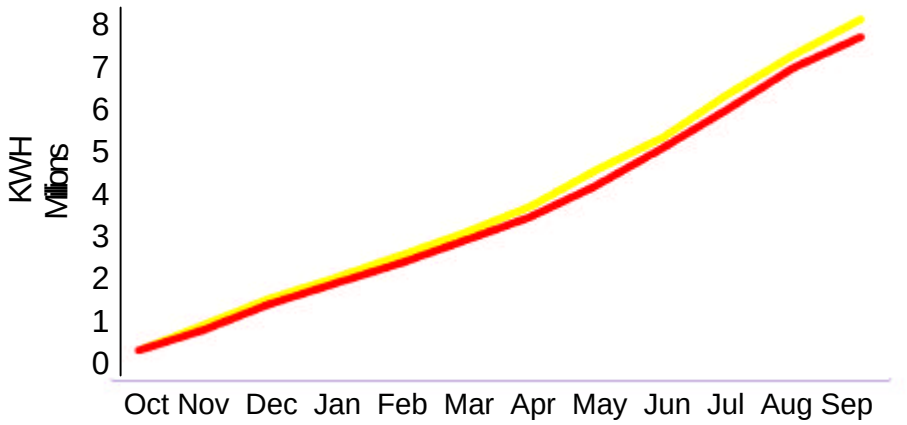


Room B104 4 day Trend

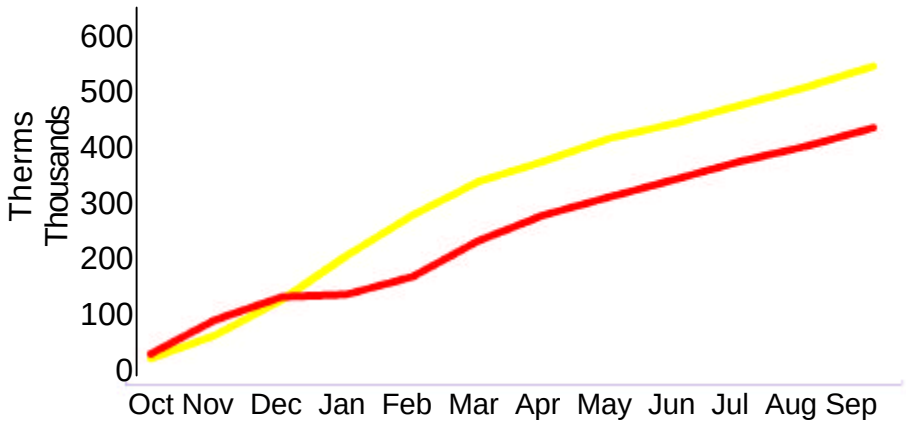


FY00 v. FY01 Consumption

Cumulative Electric Consumption

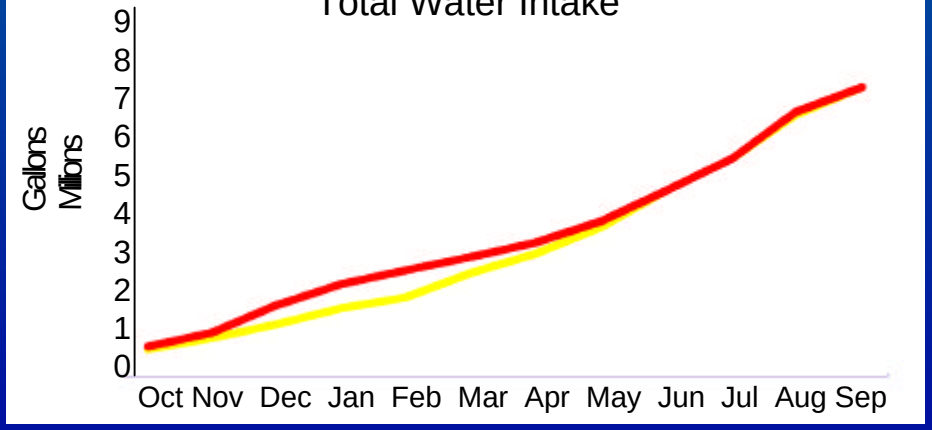


Cumulative Gas Consumption



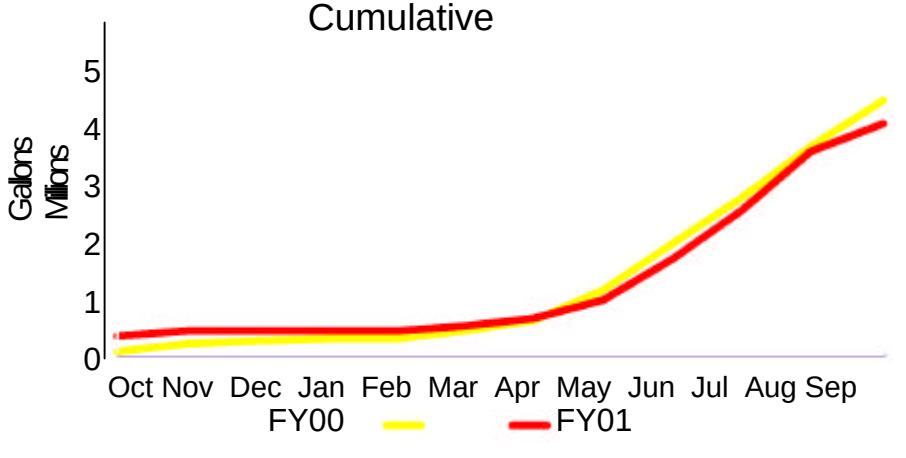
Cumulative Water Consumption

Total Water Intake

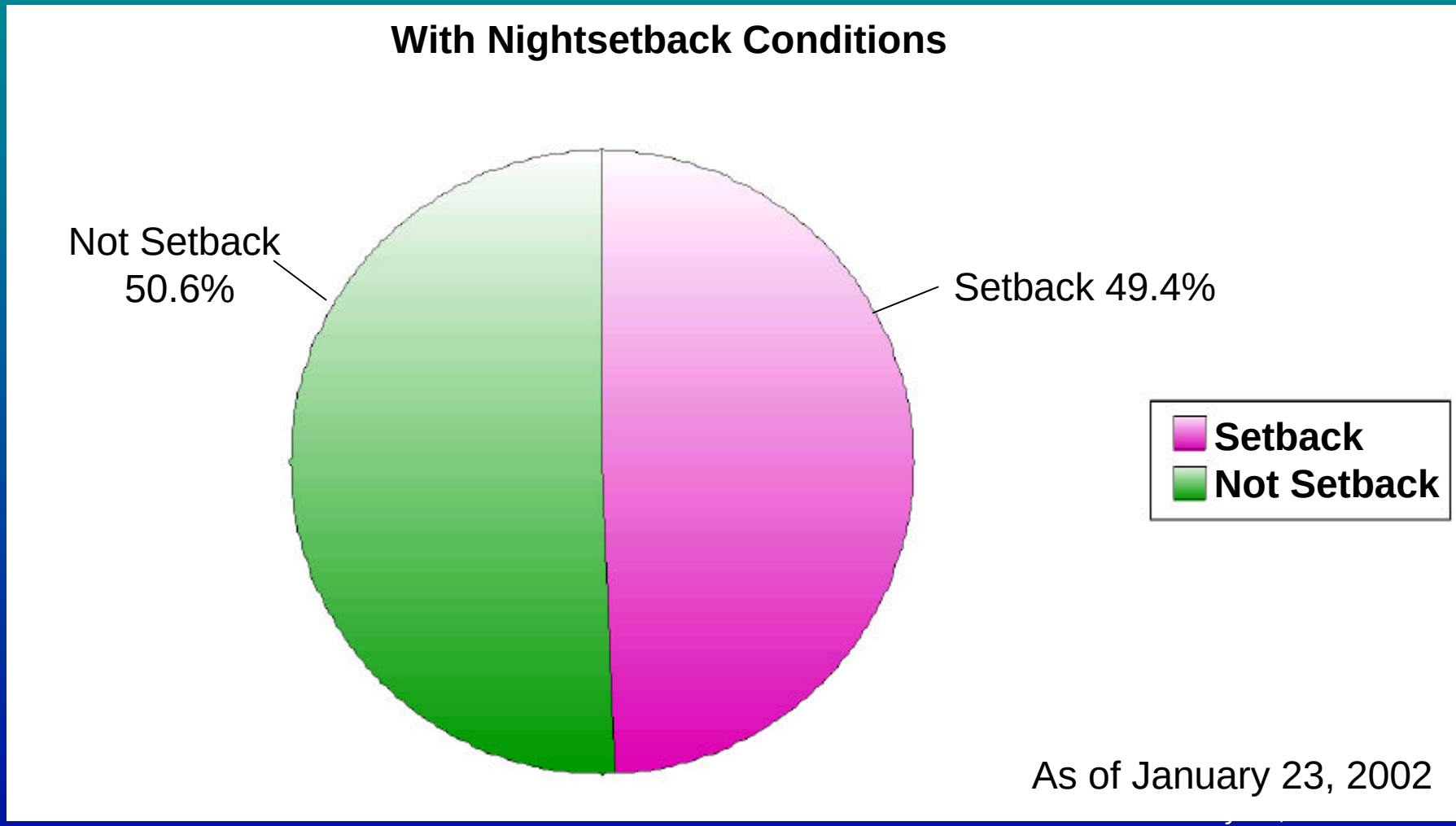


Cooling Tower Consumption

Cumulative

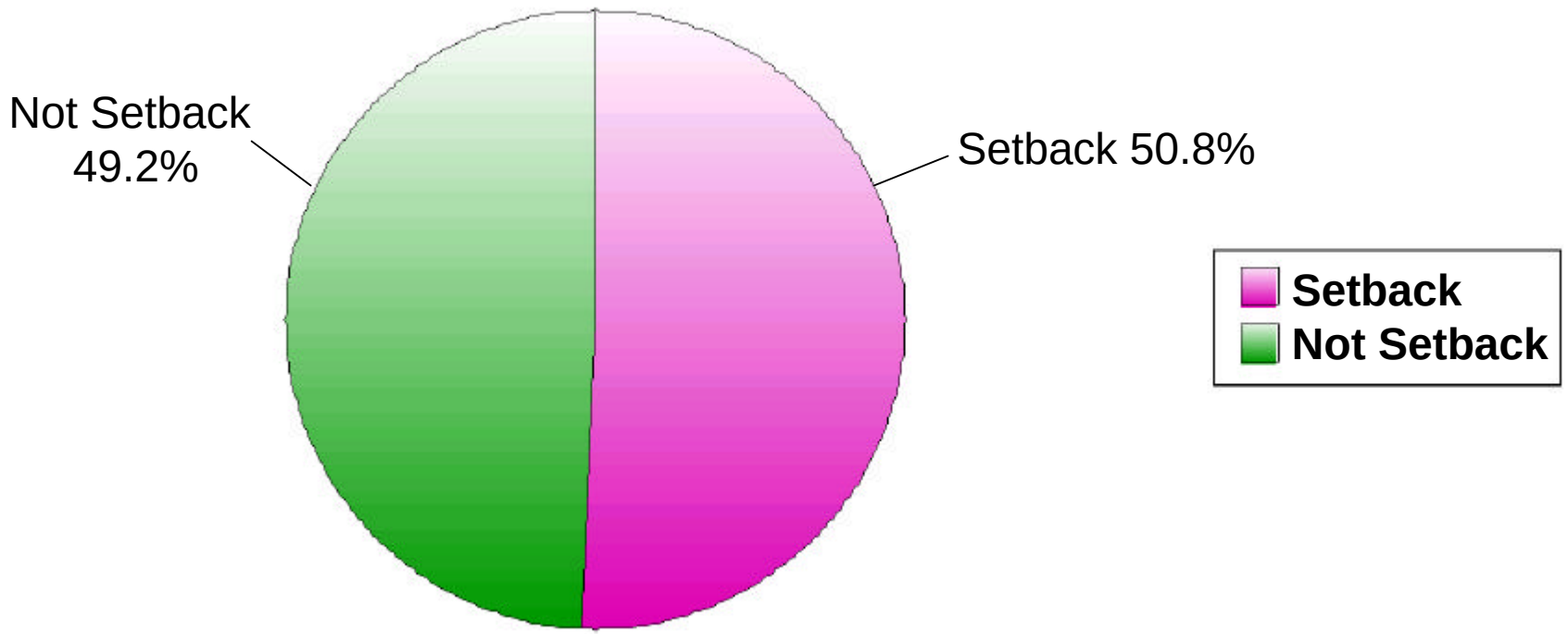


Current Breakout of Labs



Gross Square Footage Setback

Includes E, D, J and A Wings



As of October 24, 2001

Lessons

- Damper accuracy
- BTU compensation
- ACH not achievable in all cases
  - night (Unocc): 4-6
  - day (Occ): 8-12
- Expand Diversity
  - Hood use
    - Unocc: 1-5% (improved from 10-15%)
    - Occ: 15-35%
  - Hood openings 80%

Lessons 2

- DDC system requires constant attention
  - signals fail
  - dampers slip
  - recalibration random
  - sensors fail (especially fumehood sash sensors)
- Watch contract wording (capable v. delivered to perform; boiler plate v. custom requests)
- Equipment oversized. Flexible enough to deliver reasonable operational costs
- Need Bypass on AHUs for MAX Free Cooling

Recommendations

- Architectural design incentives
  - energy conservation delay payment over 12-18 months after occupancy
- Reconsider initial 25% expansion capability
- Lock in SHEM requirements early
  - exit velocity
  - diversity (# of hoods open and size of opening)
  - floor drains

Additional Recommendations

- Spend more time up front commissioning
- Look at solar heating for domestic water in summer
- VAV and VFD ARE worth it. Long term savings real.
- Get actual square foot number correct:
  - Agency calculated ~140k
  - Recalculated by ESC ~150k (7.8% larger)
    - reduces MBTU/SQ from 577 to 537 for FY01
    - 552 v. 512 FY00

To do.....

- Verify current setback conditions Occ & Unocc
- Implement setback in remaining labs
- Altered chiller water temp 45 - 48 F
- Install summer boiler system
- Look at reheat needs
- Trend labs
- Reset Chill water supply temp
- Way down the road - Heat Pipes
- ☞ Tweak

In summary

- For a facility this large expect 18-24 months to "kick the tires"
- Equipment run time decreasing with Administrative changes (chillers, AHUs, EFs and boilers)
- 3 Lab AHUs instead of 4 during OCC
- Motors have wiggle room
- All without noticable differences for the analysts and maintaining safety margins